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PTO 2003-145

Japanese Kokai Patent Publication S51-97099, published August 26, 1976; Application No. S50-21951, filed February 24, 1975; Inventor: Kiyoshi INOUE; Assignee: Inoue Japakkusu Kenkyujo

ELECTRODE FOR ELECTRICAL DISCHARGE PROCESSING

2. Claim

Electrode for electrical discharge processing characterized in that it is comprised of an area of 1 – 30% iron and the remainder is carbon, and it is baked and sintered.

3. Detailed Explanation of the Invention

The present invention concerns an electrode for electrical discharge processing; in particular, it concerns an improvement in a carbon-based electrode of graphite or the like.

Nowadays, carbon-based electrodes such as graphite or the like are most commonly used, along with copper electrodes and silver- or copper-tungsten alloy electrodes.

However, the preferable graphite electrode for the discharge processing should have particles that are as small as possible and a density that is as high as possible; the manufacturing method thereof tends to be specialized and expensive.

That is to say, it is preferred that the particles be fine and the density be high; for the discharge processing performance, the electrode wear rate is small, the processing speed is fast, and the processing surface roughness is satisfactory. For the electrode itself, the cutting mold properties are satisfactory and the precision is high. Multiple fine molds are possible, and transverse rupture strength at high strengths is high. Therefore, this is preferably used, but it has a cost that is several times or more than the carbon-

based electrodes of graphite or the like which have been normally been used conventionally.

The present invention takes these points into consideration, and with a graphite electrode having fine particles and high density, and from the various aforementioned standpoints, a carbon-based electrode with the same extent of performance has been developed. Iron (Fe) is added to and mixed with the carbon, and the item is baked and sintered.

A copper (Cu)-carbon electrode, known as a metallic carbon or the like, used as an electrode for discharge processing comprised of a mixture of carbon and a metal, is known. The composition thereof is 5 – 15% graphite with copper as the remainder, in a 100-part weight ratio, but in actuality, almost none have been manufactured recently. Besides the aforementioned copper, there are items using lead, tin, zinc, or silver, but almost none have been manufactured.

Due to the fact that copper is contained in predetermined quantities as described above, the cutting mold properties are good compared to the so-called normal graphite electrode for discharge processing (for example, apparent specific gravity of 1.72, specific resistance of 950 $\mu\Omega \cdot$ cm, hardness of Hs 45 – 46, folding strength of 430 kg/cm^2, motive elastic coefficient of 948 kg/mm^2). A fine cutting mold can be realized with high precision, and mechanical strength such as transverse rupture strength, shock resistant force, and the like are improved. These can not only be adapted as processing electrodes of WC-Co sintering alloys, or copper or an alloy thereof, but can also be adapted as electrodes of processing regions of iron-coated processed items that are half-

finished or more. Also, depending on the amount of iron contained, because of the iron; i.e., strong magnetic material, the processing layer formed by the wear of the electrode can have, for example, an area ratio of approximately 90% in a magnetic field of 8,000 e. Therefore, by jointly using a magnetic filter, there is also an advantage in that the lifespan of a filter using a filtering cloth or a filtering auxiliary agent can be made significantly long.

The invention is explained below based on embodiments. Petroleum coke, pulverized to an average particle diameter of approximately 10 μm, in a volume ratio of 40 – 60%; 20 – 50% natural or artificial graphite, with the same particle diameter; and 1 – 30% iron, with an average particle diameter of approximately 8 μm are mixed, 2,000 joules/g of energy were injected by a charging or discharging sintering method, and the conversion to a heated, sintered graphite and molding are carried out.

When baking and sintering are carried out with a furnace or the like, because the baking temperature is comparatively low at about 1,000 – 1,300°C or lower, there is less of the aggregate carbon powder used as the material composition than in the above case, and it is preferable to have the quantity of the graphite powder be greater. It is necessary for the pressurized molding pressure before baking to be 1 – 3 tons per cm^2.

The electrode material comprised of iron in a volume ratio of 1 – 30%, and the remainder carbon, manufactured as described above, has good mechanical cutting mold properties and the manufacture of the electrode is possible with high-precision dimensions. The transverse rupture strength is several times higher and the mechanical strength is high. When the discharge processing performance has a pulse of, for example,

a discharge current pulse width of 20 μs and current amplitude of 60 A, the processing speed (g per minute) and processing surface roughness (μRmax) when the WC-Co sintering alloy is processed are the same as with the graphite electrode described above, which has conventionally been used as a standard, but the electrode wear ratio has been reduced by a volume ratio of 10%, with 10% iron and the remainder carbon, as shown in the characteristic curve A of the drawing. The addition of iron is remarkable with this wear ratio. With 1% iron, the corresponding results are already present; at over 10% iron, the wear ratio deteriorates; at 30% iron, the addition results are sufficient as before.

Next, the same experiment was carried out with copper simultaneously added to the iron, as used before, and the results shown by curve B were obtained. In the case of approximately 6% copper and the remainder graph iron and carbon for the volume ratio of curve B, exceptional results were not observed based on simultaneous addition.

When an S55C iron material was processed by electrode low-wear intermediate and completed finishing with a discharge current pulse width of approximately 110 μs and a discharge current amplitude of approximately 180 A, there is about 12% wear based on the conventional graphite electrode, but based on the electrode of the aforementioned present invention, this was about 0.2% with an electrode comprised of approximately 13% iron and the remainder, carbon.

Processing of the low wear or non-wear of the electrode in the discharge processing is limited to the use of pure steel and so-called good-quality graphite electrode as a normal electrode, but based on the present invention, depending on the processing

conditions, an electrode to which iron is added and mixed can be made to be low in wear. Moreover, this is useful in removing the defects associated with graphite electrodes.

With a copper electrode, in the case of the aforementioned processing conditions of 30 μs and 60 A, there was approximately 4% wear, but when an alloy of 6% iron and the remainder copper was used, the wear was approximately 11%. Based on the processing conditions, the addition of iron to copper was effective.

Based on the present invention as described above, when iron is added, because the electrode becomes a strong magnetic body, a magnetic chuck can be used as the electrode holder, and the results are such that the mounting and detaching of the electrode are simple. Subsidiary results are simple collection of the processing layer and the like can be expected.

4. Simple Explanation of the Drawing

The drawing is a characteristic curve diagram of an embodiment of the electrode of the present invention.

Translations Branch
United States Patent and Trademark Office
December 13, 2002
Steven M. Spar

Japanese Patent Laid-open Publication No. SHO 51-97099 A

Publication date : August 26, 1976

Applicant : Inoue Japakkusu Kenkyujyo

Title : ELECTRODE FOR ELECTRIC DISCHARGE MACHINING

2. SCOPE OF CLAIMS

An electrode for electric discharge machining, which comprises Fe of 1 to 30 % by volume percent and carbon as the residual part, and which has been burned and sintered.

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3. DETAILED DESCRIPTION OF THE INVENTION

The present invention relates to an electrode for electric discharge machining, and particularly to improvement in carbon system electrode such as graphite.

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Nowadays, an electrode of carbon system such as graphite is used together with a copper electrode or a silver or copper-tungsten alloy electrode most ordinarily.

Ag

However, it is preferable for a graphite electrode that its particle size is made as small as possible and its density is made as high as possible. Therefore, the method for manufacturing the graphite electrode is made specific so that manufacturing cost thereof tends to increase.

That is, as the particle size is made more fine and the density is made higher, the electrode consumption ratio is made less, the machining speed is made larger and the machined

surface roughness is made better as electric discharge performances. Also, the electrode itself has a good cutting formability and a high accuracy. Furthermore, since a complicated and fine formation of the graphite electrode of the very fine particle size and the high density is made possible and the electrode has a high strength to mechanical impact and a high contacting force resistance, the electrodes have often been used. However, the electrode of the fine particle size and the high density has a price several times or more of the conventional electrode of such carbon as graphite.

In view of the above circumstances, the present invention has been developed, which is a carbon system electrode having performances substantially equivalent in the above-mentioned various aspects to those of the graphite electrode of the very fine particle and the high density. The carbon system electrode is prepared by adding and mixing iron (Fe) to carbon to burn and sinter them.

Fe

(7)

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特許願(1)

昭和50年2月24日

特許庁長官 斉藤英雄 殿

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明細書

1. 発明の名称 放電加工用電極
2. 特許請求の範囲
   体積百分比で1〜30%Feと、残部が炭素とからなり焼成焼結した放電加工用電極。
3. 発明の詳細な説明

本発明は放電加工用電極、特に黒鉛等の炭素系電極の改良に関する。

今日黒鉛等の炭素系電極は銅電極や銀または銅-タングステン合金電極と共に最も普通に用いられている。

しかしながら放電加工にとつて好ましい黒鉛電極としては粒子ができるだけ小さく、かつ密度ができるだけ高いものが良く、このため製作方法が特殊となつて高価となる傾向がある。

即ち粒子がこまかく、かつ密度の高いものほど放電加工性能としては電極消耗比が少なく加工速度が大きくて加工面粗さが良く、また電極自体として切削成形性が良くて精度の高い、また複雑微細な成形が可能であると共に機械的な衝撃に対して高強度で抗接力等も高いため好んで用いられるのであるが、従来通常に使用してきた黒鉛等の炭素電極に対し数倍前後またはそれ以上の価格を有するものである。

本発明はかかる点に鑑み、上記の如き超微粒子かつ高密度の黒鉛電極と上記各種の面に於て同程度の性能を有する炭素系電極を開発したもので、鉄(Fe)を炭素に添加混合し焼成焼結して成るものである。

炭素と金属との混合体から成る放電加工用電極としては銅(Cu)-炭素電極がメタリツクカーボン等と呼称されていて周知のものであり、組成としては重量百分比で5〜15%グラファイト-残部銅から成るものであるが、近時は殆んど実用されることがないのが実情である。また上記銅の外または代りに鉛(Pb)、錫(Sn)、亜鉛(Zn)、または銀(Ag)を使用したものもあつたが殆んど実用されることがなかつた。

上記の如く鉄を所定の割合で含有せしめることにより所謂通常の放電加工用黒鉛電極（例えば見掛比重1.72，固有抵抗950$\mu\Omega\cdot$cm，硬度Hs45～46，抗折力430Kg／cm^2，動弾性係数948Kg／mm^2）に比較して切削成形性が良くなつて微細な切削成形が精度高く確実に行なえ、抗折力や耐衝撃力等の機械的強度は改善され、電極消耗が少なく加工速度も同等以上で面粗さも改善され、WC－C_o焼結合金や、Cuまたはその合金の加工電極として適しているばかりでなく、Fe系被加工物の中仕上以上の加工領の電極として好適であつた。

また鉄の含有割合にもよるが，鉄即ち強磁性体であるから電極の消耗により生成した加工屑は例えば8,000Oe程度の磁界に於て体積比で約90%程度を捕集することができ、従つて磁気フイルタを併用することにより沪布や沪過助剤を使用するフイルタの使用寿命を著しく長くできる利点もあつた。

次に本発明を実施例により説明すると、平均粒径約－10μに粉砕した石油コークスを体積比で40～60%，同様な粒径の天然または人造黒鉛を20～50%，タールを5～10%，平均粒径約－8μの鉄1～30%を混合し、通電または放電焼結法により2000Joule/gのエネルギを注入して加熱焼成黒鉛化と成形を行なう。

炉等による焼成焼結の場合には焼成温度が1000～1300°C前後またはそれ以下と比較的低くなるため、材料組成としては骨材炭素粉末を上記の場合よりも少なくして黒鉛粉末の量をより多くすることが好ましい。 なお焼成前の加圧成形圧力としては1～3 ton/cm^{2}程度が必要となる。

上記の如くして製作した体積比1～30%Fe－残部炭素からなる電極材は機械的な切削成形性が良くて高精度寸法の電極製作が可能であり抗折力は数倍以上と機械的強度が高く、その放電加工性能は例えば放電電流のパルス巾30μs，電流振巾60A のパルスで、WC－C_o焼結合金を加工した時の加工速度（g/min）及び加工面粗さ（μRmax）は従来標準的に使用する前述の如き黒鉛電極と同程度であつたが、電極消耗比は図面の特性曲線Aに示す如く、10%Fe－残部炭素に於て、体積比で10%まで減少した。 このような消耗比の改善にFeの添加は顕著で、1%Feに於て既に相当の効果があり、10%をこえると消耗比は悪化するが、30%Feに於て依然として添加の効果は充分あることが判る。

次に鉄のみではなく鉄(Fe)と共に以前使用されていた銅(Cu)を同時に添加した所同様な実験で曲線Bの如き結果が得られた。 なおこの曲線Bは体積比で約6%Cu－残部グラフのFe及び炭素の場合であるが、同時添加による格別の効果は見当らなかつた。

また放電電流のパルス巾約110μs，放電電流振巾180Aというような電極低消耗の中仕上乃至仕上加工によりS55Cの鉄材を加工すると、従来の黒鉛電極によれば約1.2%程度の消耗となるが、上記本発明の電極によれば、約13%Fe－残部炭素から成る電極に於て約0.2%となつた。

放電加工に於ける電極低消耗または無消耗の加工は、通常電極として純銅を使用した場合と所謂良質の黒鉛電極を使用した場合に限られるものであるが、本発明によれば加工条件にもよるものの鉄を添加混合した電極で低消耗とすることができ、かつ黒鉛電極の欠点を除去し得るもので有用な発明である。

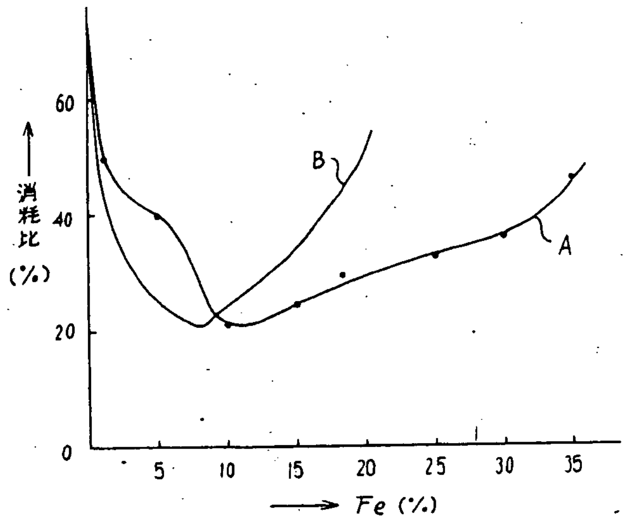
銅電極は前述の30μs，60Aの加工条件の場合約4%の消耗となるが、6%Fe－残部Cuの合金を使用すると消耗約1.1%となり、加工条件によつてはCuへのFeの添加が有効であつた。

上記の如く本発明によりFeを添加すると、電極は強磁性体となるから電極ホルダーとして磁気チヤツクを使用することができ、電極の装着等が容易になる等の効果も前述磁気による加工屑の易捕集性等と共に期待し得る副次的効果である。

4. 図面の簡単な説明

図面は本発明電極の実施例の特性曲線図である。

代理人 堀江秀己



5. 添附書類の目録

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